

ALLERGY TO METALS AS A CAUSE OF ORTHOPEDIC IMPLANT FAILURE

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Abstract
Background: A constantly growing social demand for orthopedic implants has been observed in Poland. It is estimated that about 5% of patients experience post-operation complications. It is suspected that in this group of patients an allergic reaction contributes to rejection of metal implants. **Materials and Methods:** The aim of our study was to assess contact allergy to metals in 14 people (9 women and 5 men) suffering from poor implant tolerance. In some of them, recurrent skin eruptions, generalized or nearby implants, have occurred and in 3 patients skin fistula was observed. These complaints appeared one year after operation. The patients underwent patch tests with allergens from the Chemotechnique Diagnostics (Malmö, Sweden), including nickel, chromium, cobalt, palladium, copper, aluminum. In addition, allergens, such as titanium, vanadium and molybdenum prepared by chemical laboratory in the Nofer Institute of Occupational Medicine, Łódź, Poland, were introduced. **Results and Conclusions:** Of the 14 patients, 8 persons (5 women and 3 men) were sensitized to at least one metal, mostly to nickel (7/14) and chromium (6/14). Of the 8 sensitized patients, 3 were re-operated. Owing to the exchange of prosthesis the complaints subsided, including healing up skin fibulas. These facts weight in favor of the primeval sensitizing effect of metal prosthesis and the relation between allergy and clinical symptoms of poor tolerance to orthopedic implants.

Key words:
Contact allergy, Metals, Orthopedic implants, Rejection

INTRODUCTION

In Poland, there is a constantly growing number of operations, including implants. The mostly common alloys used in the production of implants are stainless steel and vitallium. Vitallium contains mainly cobalt and chromium and also some nickel, whereas stainless steel includes 9–14% of nickel, up to 20% of chromium and also small amounts of manganese and molybdenum [1]. Titanium-aluminum-vanadium alloys are also used.

Metals with significant immunogenic potential belong to basic factors, which trigger off allergic contact dermatitis in the general population [2]. It has been estimated that

approximately 5% of patients are afflicted by post-transplant complications [3]. The issue concerning the significance of contact dermatitis to metals in the rejection of implant is the subject of discussion among researchers. The aim of the study was to assess sensitisation to metals in patients suffering from intolerance of implants.

MATERIALS AND METHODS

The study group comprised 14 non-atopic people (9 females and 5 males), aged 27–76 years (mean, 61.2 years) with no previous history of metal allergy. At the time of

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the study, 13 people due to bad health condition or retirement age were not employed. In the past they worked as teachers (3), engineers (3), drivers (2), sellers (1), dental technician (1), seamstress (1), nurse (1), and toolmaker (1). The youngest person of the group was a student of law. In 10 patients, orthopedic implants were used due to degenerative changes of joints and in 4 cases due to complications after accidents. All patients were complaining about recurrent inflammation of tissues around prosthesis. Moreover, in some of them, recurrent skin eruptions occurred, which were generalized or nearby prosthesis. Despite negative results of the microbiological examination, in 3 people skin fistulas oozing with serum content were observed. Before the orthopedic operation none of the group had reported contact allergy. After the operation only 2 young women, who had tried to wear cheap jewellery, complained about skin lesions. The rest did not take the risk. All patients were patch tested with allergens produced by the Swedish enterprise Chemotechnique Diagnostics in Malmö, including 5% nickel sulphate, 0.5% potassium dichromate, 1% cobalt chloride, 2% palladium chloride, 5% copper oxide and 100% aluminum. Additionally, 0.1% titanium oxide, 1% vanadium chloride and 0.5% molybdenum chloride, prepared by the chemical laboratory of the Norfer Institute of Occupational Medicine in Łódź, Poland, were used. All allergens (except aluminum) were suspended in petrolatum. The method of patch testing was recommended by the International Contact Dermatitis Research Group [4]. Readings were carried out 2 and 4 days after application of tests. The skin reactions were classified as follows: 0, negative reactions; +, erythema and oedema; ++, erythema and oedema with papules and vesicles confined within the chamber; +++, erythema with vesicles and papules extending beyond the chamber; and IR, irritant reaction.

RESULTS

Of the 14 patients, in 8 persons (5 females and 3 males) at least one positive test was observed. In total, 23 positive patch tests were obtained. The most sensitizing factors were nickel (7/14 people) and chromium (6/14 people).

Table 1. The positive results of patch testing in patients with complications of orthopedic implants

Allergen	Women (n = 9)	Men (n = 5)	Total (n = 14)
Nickel	5	2	7
Chromium	4	2	6
Vanadium	3	0	3
Cobalt	1	2	3
Copper	2	0	2
Palladium	2	0	2

Table 2. Allergy to metals in patients with joint loosening orthopedic implants

No/sex	Age	Nickel	Chromium	Cobalt	Vanadium	Palladium	Copper
1/F	34	+	+++	0	0	0	0
2/F	28	+++	+	+	+	++	+
3/F	39	+++	0	0	0	0	0
4/F	74	++	++	0	+	++	++
5/F	71	++	+	0	+	0	0
6/M	69	++	+++	+++	0	0	0
7/M	76	+++	0	0	0	0	0
8/M	78	0	++	++	0	0	0

F – female; M – male;
+ Erythema and oedema;
++ Erythema and oedema with papules and vesicles confined within the chamber;
+++ Erythema with vesicles and papules extending beyond the chamber.

Table 1 summarizes the results of patch tests. Allergic people usually reacted to few metals (Table 2). In all those cases, at least one sensitizing metal was present in prosthesis. Of the 8 patients, in 3 persons the implants were removed and replaced by non-allergic ones. Owing to the exchange of prosthesis the complaints subsided, including healing up skin fibulas.

DISCUSSION AND CONCLUSIONS

Allergy to metals as a cause of poor tolerance to orthopedic implants arouses controversy [5]. It is discussed whether metal sensitivity leads to instability or vice versa [6,7]. Gawkrödger [1] claims that most of the metal-sensitized patients may have orthopedic metal implants without risk, despite the fact that stainless-steel prosthesis can release nickel, chromium or cobalt ions. On the other hand,

Kanerva et al. [8] have reported the case of a 35-year-old man, who was sensitized to chromium and nickel as a result of using metal implant.

Moreover, Antony et al. [9] stated that allergy to metals is more frequent in people with endoprosthesis failure than in those from the metal-tolerance group.

The results of our study revealed that most of the examined people who showed bad tolerance to implants (8/14) were allergic to metals present in endoprosthesis. A large number of positive chromium and nickel tests catches our attention. Chromates are well known sensitizers, but metallic chromium does not induce contact allergy [10]. However, it is believed that plasma or other body fluids can transform metallic chromium to allergenic chromate salts. Nickel is the most frequent contact allergen in the general population. In some countries, sensitized men are outnumbered 13 to 1 by sensitized women [11]. It is assessed that 20% of women and 6% of men in Western Europe are allergic to nickel [12]. In older women, sensitization is rarely observed. Kieć-Świerczyńska [13] claims that in a group of 77 women aged over 50 years allergy to nickel occurred in 6 (7.8%) people. Whereas, in our study five of nine women and two of five men were sensitized to nickel. This frequency is evidently higher than in the general population, especially because it concerns older people. The positive patch test with palladium and copper occurred only in people sensitized to nickel, which could result from cross-reactivity between these metals [14,15]. It is important to note that in all sensitized patients, recurring inflammations of tissues around implants and periodical skin lesions appeared approximately one year after operation. In addition, in 3 patients skin fistulas oozing with serum were created and bacteriological examinations were negative. Nevertheless in some of the patients occupationally exposed to metals before the operation the skin allergic diseases did not occur. By now of the eight patients three persons were re-operated with non-allergic-metal implants. In all cases, the exchange of endoprosthesis contributed to the disap-

pearance of complaints, including healing up skin fistulas. Those facts weight in favor of the primeval sensitizing effect of metal prosthesis and the relation between contact allergy to implant components and clinical symptoms of poor tolerance of orthopedic implants.

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